Marwadi University

Syllabus for Diploma Engineering

Electrical Engineering

Semester – VI

Subject Name: Solar and Wind Power Technologies

Subject Code: 09EE1608

Diploma Branches in which this subject is offered: Electrical Engineering

Objective: Our state and the several states in our country, where a large number of solar and wind grid connected electric power generation's and competent technicians to maintain these renewable energy power generation units is a dire need of the our industry. It is to satisfy this need, that this subject/course been designed so that the diploma electrical engineer would be able to maintain the installations thereby minimizing the downtime. It is presumed that the students have studied in basic things of solar and wind power technology. The main objective of this course is to help the student to attain maintain the efficient operation of various types of solar and wind power technologies industry identified competency through various teaching learning experiences.

Credits Earned: 3 Credits

Course Outcomes: After completion of this course, student will be able

1. To maintain concentrated solar power and solar photovoltaic power plants
2. To maintain the solar non electric equipment.
3. To maintain solar PV electronics, MPPT systems, off-grid and on-grid solar power plants
4. To identify the various types of wind power plants and their auxiliaries
5. To maintain the normal working of large and small wind turbines
6. To troubleshoot the common faults of large and small wind power plants

Pre-requisite of course: Basic knowledge of Generation of Electrical Power, Electrical Machine and Power system

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term work	
2	0	2	3	50	30	20	25	25	150

Contents:

Unit	Topics	Contact hours	Weightage (%)
1	**Solar and Wind Energy** • Introduction • Solar map of India: Global solar power radiation • Different types of solar water heaters: Construction, working, specifications and installation • Solar heating systems, Solar drying and different types of solar cookers, Solar lighting. • Wind power scenario in the world and India • Characteristics of wind energy: Wind movement, wind profile, roughness, and effects of obstacles in wind path.	03	11
2	**Concentrated Solar Power and Solar PV Systems** • Introduction • Concentrated Solar Power (CSP) plants or solar thermal electric systems • Parabolic Trough and Dish: Construction, working and specifications • Power Tower, Fresnel Reflectors: Construction, working and specifications • Preventive maintenance of CSP plants • Solar PV cell: Types construction, working, Typical specifications of solar cells • Solar PV working principle: Series and parallel connections of solar modules • Solar Photovoltaic (PV) system: components layout and working. • Solar modules, arrays and their standard specifications • Roof top and streetlight solar PV systems and typical specifications	07	25
3	**Construction and Working of Wind Power Plants.** • Introduction • Types of wind power plants: Small and large wind turbines; Horizontal and Vertical axis; Upwind and Downwind, One, Two and three blades; constant and variable Speed; Geared, Direct-drive and Semi-Geared WPPs; WECS, WEGs, WTs • WPP Tower Types: Lattice; tubular: steel, concrete, hybrid, ladders, cables	08	28

	• Wind Turbine Terminologies: Cut-in, cut-out and survival wind speeds, Threshold wind speeds, rated power, nominal power, Wind Power Curve • Major parts and Functions of WPP: Rotor blades, hub, nacelle, tower, electric sub-station, nacelle layouts of Geared, Direct-Drive and Semi-Geared WPPs, Main shaft, gearbox, electric generator, electronic control panels • Rotation principles: Drag and Lift principle, thrust and torque of wind turbine rotor. • Different types of Sensors: Anemometer, tale vane, wind vane, rpm sensors of main shaft and generator, temperature sensors of nacelle, gearbox and generator; cable untwisting and vibration sensors. • Different types of Actuators: Electric and hydraulic pitching and yawing mechanisms, cable untwisting and braking mechanisms • Working SWTs: Direct-drive and Geared. • Electrical generators in SWTs: permanent magnet synchronous generators, induction generators • SWT towers: Lattice tubular type, hydraulic towers, ladders, cables		
4	**Maintenance of Solar and Wind Power Plants** • Introduction • Maintenance and Preventive maintenance of CSP plants and solar PV system. • General maintenance of WPPs: preventive maintenance schedule of actuators such as yaw control, pitch control, braking mechanisms and sensors; oiling and greasing; electric and electronic equipment related; Power electronic devices and converters in different types of SWTs: thyristors, power transistors, tower related; minor repairs, some tips • Scheduled Maintenance: of Stall and Pitch and Active Pitch controlled WPPs • Unscheduled maintenance: operational factors, design faults, wear and tear of components, spurious trip, Major repairs • Common electrical and mechanical faults in SWTs	**06**	**22**
5	**Grid Connection of Solar and Wind Power Plants** • Introduction • Solar off grid systems: layout and specifications • Solar Grid tied (on grid) systems: Working principle of grid-tied dc-ac inverter, grid synchronization and	**04**	**14**

	active power export, Net metering: main features and working • Grid interface issues of wind power • Grid operational issues of wind power. • Solar-wind Hybrid systems: Layout and specifications.		

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
40%	45%	8%	7%	0%	0%

Suggested List of Experiments:

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	1	To dismantle and assemble solar power heaters	4
2	2	To troubleshoot a CSP plant	2
3	2	To Assemble and dismantle a solar PV cell, module, array system with without battery connection	4
4	2	To Connect the solar PV modules in series and parallel	2
5	3	To identify the various parts of a WPP	4
6	3	To troubleshoot direct-drive SWT and geared SWT	4
7	3	To Interpret the wiring of a SWT electric-electronic control panel	2
8	4	To troubleshoot a solar PV system	2
9	5	To troubleshoot solar off-grid systems and solar net metering systems	2
10	5	To troubleshoot solar-wind hybrid systems.	2

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses.

References:

1. Chetan Singh Solanki, "*Solar Photovoltaic: Fundamentals, Technologies and Application*", PHI Learning, New Delhi, 2009.
2. Chetan Singh Solanki, Brij M. Arora, Vasi Juzer, Mahesh B. Patil, *"Solar Photovoltaic: A Lab Training Module",* Cambridge University Press, New Delhi, 2009.
3. Earnest, Joshua, " *Wind Power Technology*", PHI Learning, New Delhi, 2014
4. Joshua and Wizelius, Tore Earnest, *"Wind Power Plants and Project Development",* PHI Learning, New Delhi, 2011.
5. S.P. Sukhatme, J.K.Nayak, *"Solar Energy",* Tata McGraw, New Delhi, 2010.
6. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, *"Renewable Energy Systems",* Pearson Education New Delhi, 2014
7. S. N. Bhadra, D. Kastha, S. Banerjee, *"Wind Electrical Systems installation",* Oxford University Press, New Delhi, 2015

Supplementary Resources:

1. https://nptel.ac.in/course.php
2. https://nptel.ac.in/courses/108105058/
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112105051/lec1.pdf
4. https://nptel.ac.in/courses/108108078/
5. http://www.awea.org/Resources/Content.aspx?ItemNumber=900
6. http://www.windpowerwiki.dk/
7. http://learn.kidwind.org/teach/
8. http://www.fao.org/docrep/010/ah810e/AH810E11.htm
9. http://www.renewables-made-in-germany.com/en/renewables-made-in-germany-start/solar-energy/solar-thermal-energy/overview.html/
10. http://www.renewables-made-in-germany.com/en/renewables-made-in